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Research Paper Applied Geology

Petrography of the Volcanic and Metavolcanic Rocks of Middle Siang Valley, East Siang District, Arunachal Pradesh, India

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ABSTRACT

The volcanic and metavolcanic rocks of middle Siang valley constitute a part of the famous Abor volcanics of Arunachal Pradesh and is locally known as Geku volcanics and Gatte/ Tuting metavolcanic (Singh, 1993) The Geku volcanics has produced a mosaic of volcanic products of various natures and locally interbedded with Palaeocene-Eocene sediments of Geku Formation of Yinkiong Group. Intercalation of lava in sedimentary beds or lenses is common. At places lava in the form of a-a type is found to flow over the sedimentary rocks. These all indicate that the volcanism and the sediment deposition in the basin were penecontemporaneous. Also, presence of pyroclasts in the form of rhyolitic ignimbrite, agglomerate, lapillies and fragmentary nature of the volcanics suggest the explosive nature of the volcano. Occurrences of basaltic lavas are observed at certain places.

Further upstream of the Siang river in between Pugging and Rikor village occurrences of metavolcanics and metapellites are found. The metavolcanics are the product of low grade regional metamorphism (upto Phrenite- Pumpeyllite facies) and local dynamic metamorphism (upto Green-schist facies). These are mainly subschistose and became schistose near the vicinity of the shear zones and faults.

The meta-volcanics of the area under study comprise mainly of meta-basalt, meta-andesite, meta-dacite and actinolite-schist. In the schistose metavolcanic rock presence of meta-pellitic patches and compressed pumice, shards and lapillies are observed. Numerous quatzofeldspathic , feldspathic and calcitic veins are found to occur along and across the foliation planes of these metavolcanic rocks.

It is observed that the volcanics of the area under study are associated with shallow water sediments and are generally intercalated, contemporaneous, folded and metamorphosed and can be related to tensional tectonic conditions. Tensional fractures during the depositional regimes of the Lesser Himalayan tectonic basins could reach upper mantle through which eruption may take place. The magmas may be derived from the partial melting of upper mantle.

Keywords : Abor volcanics, Geku volcanics, Paleocene-Eocene, a-a lava, intercalated lava, metavolcanic, metapelite

INTRODUCTION:

The area under study is a part of middle Siang Valley and is bounded by latitudes 280 21'24''N-28050'0'' N and longitudes -9503'41'' E-94050'0''E. It lies in the Survey of India Toposheet No. 82L/14 and 82L/13.

The area shows numbers of distinct faults and folds. A north–east trending structure demarcating more or less the western boundary of the Abor Volcanics, known as the Siang Fracture can be identified on the LANDSAT Satelite Imegery. Structural trend of the sequence varies generally between NNW and NNE. The pattern of minor folds and the disposition of the different rock units suggest that the whole sequence has been thrown into steeply plunging isoclinals folds later refolded by steeply plunging open folds.

The stratigraphic succession of the area understudy is shown below.

GROUP	FORMATION	LITHOLOGY
Yinkiong	Dalbuing	Alteration of grey to dark grey limestone and shale containing foraminifers ? ? ? ? ? ? Interbedded purple and pale green shale, black shale and sandstone. Dark grey sandstone and associated purple and nodular grey shale containing plant fossils. White to grayish white medium grained quartzite.
	Geku	Purple and green shale (424m). Dark grey to grey vesicular and amygdaloidal mafic volcanic (650 m). Purple and green shale. Micaceous siltstone Purplish and grey welded tiffs (? Ignimbrite).

The volcanic rocks of the Geku area are associated with Yingkiong Group of rocks deposited during Palaeocene-Eocene time, while the Metavolcanics have tectonic contacts with YingKiong and Rikor Group of rocks. The volcano produced a mosaic of volcanic products of various nature and are locally interbedded with the rocks of Yinkiong Group(fig-3.1). At places lava in the form of a-a type is found to flow over the sedimentary rocks(fig-3.2). Also, presence of pyroclasts in the form of rhyolitic ignimbrite, agglomerate, lapillies and fragmentary nature of the volcanics suggest the explosive nature of the volcano(fig.3). Occurrences of basaltic lavas are observed at certain places. Exposures of both volcanic and meta-volcanics are shown in fig. 3.

Petrography of the rock types

The petrography of the volcanic and metavolcanic rocks of the area under study are shown in Tables1- 8 and Figure 5. Field photographs are shown in Figure 3 and photomicrographs are shown in Figure 4.

Discussion and conclusions

The volcanic and metavolcanic rocks of Middle Siang Valley of Arunachal Himalayas are considered to be a part of the famous Abor Volcanics and named as Geku Volcanic. This Geku Volcanic has produced a mosaic of volcanic products of various nature and locally interbedded with Palaeocene-Eocene sediments of Geku Formation of Yinkiyong Group. At places lava in the form of a-a type is found to flow over the sedimentary rocks. These indicate that the volcanism and the sediment deposition in the basin were penecontemporaneous.

Petrographic study reveals that the volcanics are mainly-Basalt-andesite-dacite-rhyodacite in character. The basaltic rocks are composed mainly of plagioclase, augite, ironoxide, quartz and pseudomorph of olivine. In the uppe part of the area some leucite bearing basalts and tephrites are also found.Andsites are mostly composed of plagioclase, pigeonite, ironoxide, palagonite and rock fragments. The dacitic and rhyodacitic rocks are composed mainly of plagioclase (sodic), augite, quartz and ironoxides. Further upstream of the Siang river in between Pugging and Rikor village occurrences of metavolcanics and metapellites are found. The metavolcanics are the product of regional burial metamorphism (upto Prehnite- Pumpeyllite facies) and local dynamic metamorphism (upto Green-schist facies). These are mainly subschistose and became schistose near the vicinity of the shear zone and fault.The metavolcanics of the area under study comprise mainly of meta-andesite, meta-dacite and actinolite schist. In the schistose rock presence of meta-pellitic patches and compressed pumice, chert and lapillies are found to occur. In muscovite-quartz schist which is a meta-pelitic rock large clasts of chloritoid are found to occur.The basalts are alkalic to sub-alkalic in nature but toward upstream of Siang River a more alkaline (potassic) variety is found to occur. It is observed that the volcanics of the area under study are associated with shallow water sediments and are generally intercalated contemporaneous, folded and metamorphosed and can be related to tensional tectonic conditions. Tensional fractures during the depositional regimes of the Lesser Himalayan tectonic basins could reach upper mantle through which eruption may take place. The magmas may be derived from the partial melting of upper mantle.

Description of figures:

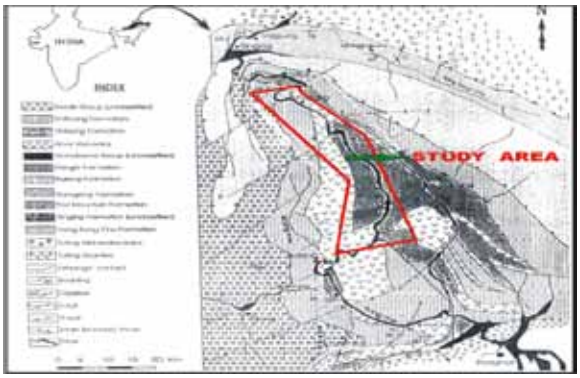


Fig: 1. Location map of the area under study

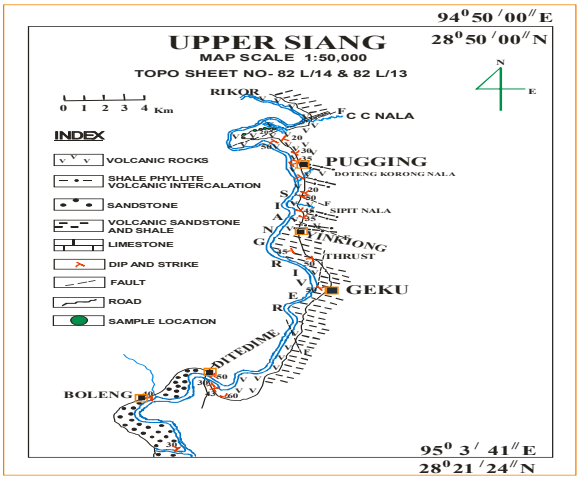


Fig 2. Geological map of the area

Fig: 3
FIELD PHOTOGRAPHS

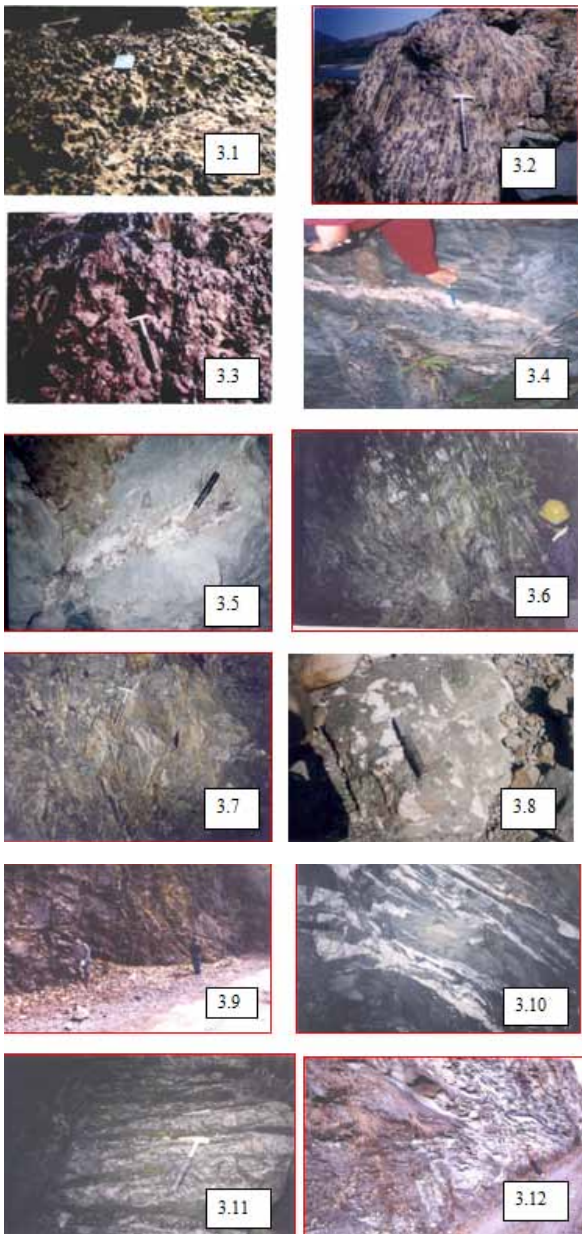
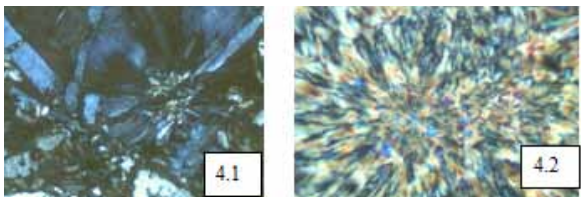
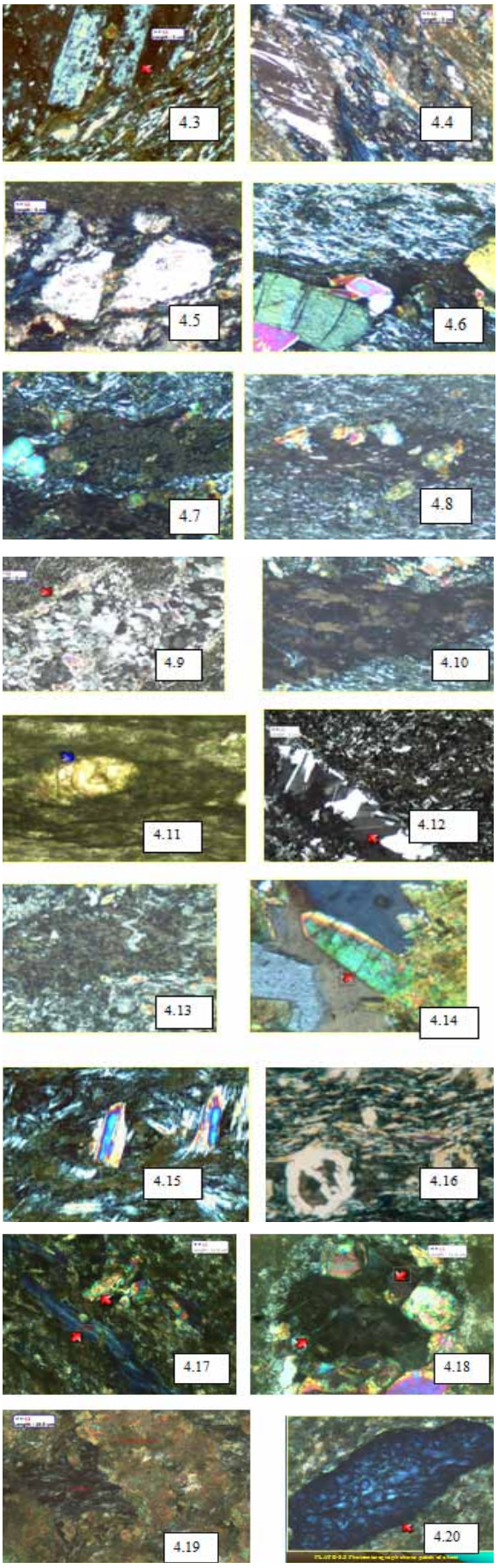


Fig 3.1: Intermixing of lava and sediment
Fig 3.2: a-a lava mixed with sedimentary rocks
Fig 3.3: Rhyolitic ignimbrite
Fig 3.4: Feldspathic vein in metavolcanic rock
Fig 3.5: Feldspathic vein in metavolcanic rock
Fig 3.6: Foliated meta volcanic
Fig 3.7: Actinolite Schist
Fig 3.8: Large irregular amygdales in basalt
Fig 3.9: Metabasalt
Fig 3.10: Foliated metavolcanic rock
Fig 3.11: Epidote bearing metavolcanic rock
Fig 3.12: Metabasalt

Fig: 4.
Photomicrographs

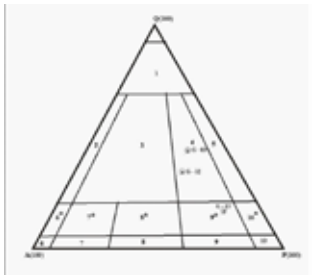




Description of photomicrographs

Fig 4.1: Basalt
Fig 4.2: Sphreluties in vesicles
Fig 4.3: Corroded plagioclase feldspar in actinolite schist
Fig 4.4: Patches of metapellite in actinolite schist
Fig 4.5: Large clast of chloritoid in metapellitic patch
Fig 4.6: Patches of rhyolitic pumice and zeolite in metaandesite
Fig 4.7: Compressed pumice and chlorite in meta-andesite
Fig 4.8: Compressed with secondary mineral.
Fig 4.9: Microcrystalline quartz in vesicles
Fig 4.10: Volanic chert in actinolite schist
Fig 4.11: Clast of epidote in sericite quartz schist
Fig 4.12: Adularia vein
Fig 4.13: Patches of rhyolitic pumice in metavolcanic rocks
Fig 4.14: Euhedral epidote
Fig 4.15: Actinolite bundles as uralites
Fig 4.16: Lithophysae in actinolite schist
Fig 4.17: Compressed volcanic glass and development of epidote grains in basaltic pumice
Fig 4.18: Pathces of volcanic shard
Fig 4.19 Phyllonite
Fig 4.20: Volcanic chert in vesicle

Fig. 5: Plots of rocks in QAPF diagram



Plot of sample G-03, sample G-12 and sample G-13 in QAPF diagram after IUGS, 1973

Description of tables

Sample No.	Megascopic Charcterstics	Microscopic character		
		Mineralogy	Texture and Structure	Rock type
GEO-RB-13B (UB)	The rock is greenish black to green color and is very fine grain and foliated.	The rock is composed mainly of plagioclase (feathery), clinopyroxene, actinolite, sericite and quartz. Patches of metapellite consisting of chloritoid porphyrobalast are observed. Plagioclase and pyroxene occur as relicts.	Fine grained layered volcanic rock. Boundaries of quartz and feldspar are corroded. The rock shows schistose structure.	Sericite-Actinolite Schist.
LDR 4A -75	The rock is green in colour and vesicles are filled with secondary mineral.	The rock is essentially composed of augite (uralite), secondary hornblende and orthoclase (phenocryst) and actinolite. Few olivine grains are also present.	Fine grained volcanic rock. Foliated character is well observed. Glass occurs as patches and lenticular veins. Vesicles are present and filled up with fibrous zeolites and epidote. Patches of compressed volcanic shards and pumice are common which are in alignment with foliation plane.	Actinolite-schist
GEO D 12	The rock is fine grained and grayish green in colour.	The rock is essentially composed of mainly sericite with few muscovite flakes and epidot as porphyroblast and fine grained quartz.	It is low grade metamorphic rock. Epidot porphyroblast shows random orientation to the foliation plane and mostly developed in the pumicic lava. The sericite and quartz grains are the products of recrystallization of pellitic sediments.	Sericite -Quartz-Epidote schist
P-32	The rock is green in colour and is fine grained and sheared.	The rock is essentially composed of epidote, quartz, analcime, few actinolites and some euhedral epidote in the vein. The groundmass of the rock is ferromagnesian	Fine grained and sheared rocks. Quartzo- feldspathic veins are common and euhedral epidotes are found to develop in the vein boundary. Epidotization is common	Metavolcanic rock with epidotization

Table.1

Sample No.	Megascopic Characterstics	Microscopic character		
		Mineralogy	Texture and Structure	Rock type
PUG1	Fine grained metavolcanic rock, light green in colour, highly altered	Highly altered rock sericitised. Altered minerals are epidote and chlorite.	The rocks shows schistose fabrics and highly sericitised, compressed volcanic shard are also observed.	Sericite Schist
PUG2	Rock is fine grained, light greenish in colour	The rock is mainly composed of feathery plagioclase, sericite, chlorite, epidote, quartz and Iron ores. Compressed pumicic lava and quartz veins are common	The rock showing schistose fabric. In the compressed pumicic lava development of epidote aggregates	Metavolcasnic Rock
PUG3	The rock is greyish white in colour.It is fine grained, several quartz and calcite veins are observed.	The rock consist mainly of Epidote, Chlorite, Orthoclase and Quartz. Several Quartz and Calcitic veins are also observed. Near the vicinity of calcite vein euhedral forms of epidote are observed. Orthoclase are dominant at the vicinity of quartz vein.	The rock is a fine grained metavolcanic rock. Epidotization of the early minerals is well observed. Two varieties of epidotes are found, one is the result of epidotization and the other epidotes developed in the vicinity of calcitic veins are euhedral in nature.	Calc-silicate rock
PUG4(A)	The rock is fine grained metavolcanic rock showing schistosity. The rock is olive green in colour.	The rock is essentially consist of feathery Pyroxene, Chlorite, Epidote granules and Iron ores. Quartz Veins are developed along the fractures	Fine grained rock showing schistosity. At places metapelitic patches are observed where chloritoid clasts are found .	Schistose volcanic rock

Table.2

Sample No.	Megascopic Characterstics	Microscopic character		
		Mineralogy	Texture and Structure	Rock type
PUG13	The metavolcanic rock is greyish black in colour, fine grained	The rock constituted mainly by feathery pyroxene, chlorite, epidote granules and iron ores. Quartz vein found to develop along the fracture. The rock is highly altered.	Fine grained rock with sub schistose fabric	Metabasalts
PUG14	The rock is fine grained, reddish brown in colour	The rock consist mainly of accicular plagioclase in the lava fraction. Large patches of volcanic glass are common and at places chlorites are developed. As a whole, the rock is a basaltic lava.	Very fine grained volcanic rock	Basaltic lava
R2	The rock is fine grained, greyish in colour	Highly altered volcanic rock consisit mainly of plagioclase, epidote, chlorite and volcanic glass. Epidotization is well observed	Fine grained volcanic rock, highly altered	Altered basalt
70/1	The rock is fine grained, greyish black in colour	Fine grained volcanic rock consists mainly of accicular plagioclase, pyroxene and amygdals of chalcedony, sparrycalcite, epidote granules, chlorite etc.	Fine grained volcanic rock	Amygdaloidal basalt

Table.3

Sample No.	Megascopic Characterstics	Microscopic character		
		Mineralogy	Texture and Structure	Rock type
PUG4(E)	The rock is fine grained, greyish black in colour The fine grained limestone with numerous calcite and quartz vein	In the quartz vein of the rock development of calcite minerals and epidote are well observed	Fine grained rock. Development of epidote in the quartz vein is indicative of the reaction of calcite and quartz	Limestone
PUG5	The rock is fine grained, greyish in color	Fine grained rock indicating intercalation of volcanic and argillaceous sedimentary rock. The volcanic counterpart is characterised by small grains of augite, plagioclase, chlorite and epidote granules. Epidotization is quite common	Fine grained rock	Intercalated volcanic rock with fine grained sedimentary rock
ST-11	The rock is fine grained, greyish in colour	Very fine grained and highly altered. The rock constituted mainly by epidote, chlorite and is intercalated with fine grained sedimentary rock. Epidotization is found to be prominent converting the parent rock to somewhat like that of calcsilicate	Fine grained low grade metamorphic rock due to hydrothermal metamorphism and epidotization. (Plate-5.4 & Plate-5.5)	Low grade metamorphic rock
PUG 12	The rock is black in colour, fine grained.	Fine grained rock consisting sericite, chlorite, muscovite and several microfolod. Calcite and quartz veins are common in the rock.	Fine grained phyllitic rock with schistose. Plane microfolds are common. Crenulation cleavages are also well observed. (Plate-5.6)	Phyllonite

Table.4

Sample No.	Megascopic Characterstics	Microscopic character		
		Mineralogy	Texture and Structure	Rock type
PUG13	The metavolcanic rock is greyish black in colour, fine grained	The rock constituted mainly by feathery pyroxene, chlorite, epidote granules and iron ores. Quartz vein found to develop along the fracture. The rock is highly altered.	Fine grained rock with sub schistose fabric	Metabasalts
PUG14	The rock is fine grained, reddish brown in colour	The rock consist mainly of accicular plagioclase in the lava fraction. Large patches of volcanic glass are common and at places chlorites are developed. As a whole, the rock is a basalt	Very fine grained volcanic rock	Fine grained basalt
R2	The rock is fine grained, greyish in colour	Highly altered volcanic rock consisit mainly of plagioclase, epidote, chlorite and volcanic glass. Epidotization is well observed	Fine grained volcanic rock, highly altered	Altered basalt
70/1	The rock is fine grained, greyish black in colour	Fine grained volcanic rock consists mainly of accicular plagioclase, pyroxene and amygdals of chalcedony, sparrycalcite, epidote granules, chlorite etc.	Fine grained volcanic rock	Amygdaloidal basalt

Table.5

MODAL COMPOSITION AND COLOR INDEX (C.I.) OF THE SAMPLE-G-03

Constituent Mineral	Volume %	C.I (in %)
Quartz Plagioclase Augite Iron Oxide Amygdales Orthoclase	28.70 24.80 14.83 19.27 9.20 3.2	24.10
	Total-100	

Table.6.1

RE CALCULATED VOLUME PERCENTAGE OF FELDSPATHOID (F), PLAGIOCLASE (P), ALKALI-FELDSPAR (A).

Q+ A + P = 56.70

Q	A	P	Total
50.62	5.46	43.47	100

Table.6.2

Modal composition and colour index (C.I.) of the sample G-12
Where, C.I. = Sum of the mafic minerals.

Constituent minerals	Volume percentage	C.I. (in %)
Quartz	8.31	51.90
Plagioclase	19.30	
Augite	18.70	
Iron-oxide	33.2	
Orthoclase	10.53	
Amygdales	9.96	
Total	100.00	

Table.7.1

Recalculated volume percentage of Quartz (Q), Plagioclase (P), Alkalifeldspar (A)

Q + A + P = 38.14

Quartz (P.C)	Alkalifeldspar(P.C)	Plagioclase(P.C)	Total (P.C)
21.79	27.61	50.60	100.00

Table.7.2

Modal composition and colour index (C.I.) of the sample G-13

Where, C.I. = Sum of the mafic minerals.

Constituent minerals	Volume percentage	C.I. (in %)
Quartz	5.00	36.82
Plagioclase	32.26	
Augite	21.77	
Iron-oxide	15.05	
Volcanic glass	19.80	
Calcite	15.40	
Geolite	2.54	
Total	100.00	

Table8.1

Recalculated volume percentage of Quartz (Q), Plagioclase (P), Alkalifeldspar (A)

Q + A + P = 37.26

Quartz (P.C)	Alkalifeldspar(P.C)	Plagioclase(P.C)	Total (P.C)
13.42	0.00	86.58	100.00

Table8.2

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